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United States Patent [19]

Dunn et al.

[11] Patent Number: **5,600,706**[45] Date of Patent: ***Feb. 4, 1997****[54] METHOD AND SYSTEM FOR DETERMINING THE POSITION OF A MOBILE RECEIVER**

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[*] Notice: The portion of the term of this patent subsequent to Jan. 7, 2014, has been disclaimed.

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Related U.S. Application Data

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[51] Int. Cl.⁶ **H04M 11/00; H04B 7/185; G01S 3/02**

[52] U.S. Cl. **379/59; 379/60; 342/357; 342/450; 342/457; 342/463**

[58] Field of Search **379/59, 60; 455/33.1, 455/33.4, 54.1, 56.1; 342/450, 457, 357, 463**

[56] References Cited**U.S. PATENT DOCUMENTS**

4,799,062 1/1989 Sanderford 342/450

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|-----------|--------|-----------|----------|
| 4,891,650 | 1/1990 | Sheffer | 342/457 |
| 5,043,736 | 8/1991 | Darnell | 342/357 |
| 5,103,459 | 4/1992 | Gilhousen | 379/59 |
| 5,208,756 | 5/1993 | Song | 455/54.1 |
| 5,216,429 | 6/1993 | Nakagawa | 342/450 |
| 5,218,367 | 6/1993 | Sheffer | 379/59 |
| 5,218,629 | 6/1993 | Dumond | 379/59 |
| 5,221,925 | 6/1993 | Cross | 342/457 |
| 5,223,844 | 6/1993 | Mansell | 342/357 |

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[57] ABSTRACT

A position system and method utilizes a plurality of range transceivers located at known fixed locations and which are adapted to transmit approximately synchronized digital range signals for receipt by both a primary receiver and a supplemental receiver, the former disposed at a known location and the latter disposed at an unknown location. The range transceivers are adapted to transmit pulse sequences which include an error portion corresponding to the approximate synchronization error of each range signal. This error portion is constantly updated in accordance with the last determined synchronization errors of the corresponding range signals received by a secondary transceiver. In an alternative embodiment employing Code Division Multiple Access (CDMA) technology, the range transceiver time stamp on transmitted range signals may be adjusted to account for the measured timing error for a given range transceiver. The supplemental receiver receives the range signals and uses the same in accordance with known time of arrival or time difference of arrival calculation techniques to determine the position of the supplemental receiver.

60 Claims, 8 Drawing Sheets

